SONA SWEEP MODEL M

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Operating Instructions

Issue C

SONA-SWEEP MODEL M

KAY ELECTRIC COMPANY

Pine Brook, N.J.

CApital 6-4000

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SECTION I
FUNCTION AND DESCRIPTION

1.1 INTRODUCTION.

The Sona-Sweep Model M is an all-electronic sweeping oscillator, utilizing both linear and logarithmic sweeps, designed for examining circuits in the 20-cps to 200-kc range. When used in conjunction with an oscilloscope, it produces a pictorial representation of the response curve of the circuit being examined.

Three separate sweep ranges, 20 cps to 2 kc, 200 cps to 20 kc, and 2 kc to 200 kc are provided. The 20 kc sweep incorporates a band switch which allows the operator to vary the center frequency of the sweep between 20 cps and 200 kc in 20-kc steps. Double heterodyning techniques provide stable sweeps over the entire range of the instrument.

In addition to the linear sweep, useful for most general applications, this instrument provides a logarithmic sweep, which may be used advantageously when examining the low-frequency end of audio and video circuits where the response may tend to "roll-off", or rise. The center frequency of the linear sweep is variable throughout the entire range, with a read-out of the center frequency shown on a front panel dial. Sweep width of the linear sweep is continuously variable over the range of the sweep.

The Sona-Sweep Model M generates a high-level sweeping output over its entire frequency range and is continuously variable to 5.0 volts rms from 65 db below 5.0 volts. This output is developed across a nominal 600-ohm characteristic output impedance. Peak tuning of crystal oscillators and high-quality filtering techniques hold this output within $\pm$0.5 db over the widest sweep width. A front panel control allows the operator to switch to a c-w output which is continuously variable over a range of 20 cps to 200 kc. The frequency of the c-w output is read directly from the Center Frequency and Band Selector dials.

A wide choice of sweep repetition rates is available, permitting the selection of an optimum rate for each application. A fixed repetition rate, which is locked in at 30 cps, is useful for most general purposes, while a sweep repetition rate continuously variable between 0.2 and 25 cps, in three ranges, is provided for investigating high-Q circuits, which may have sharp variations in response which the faster repetition rates may not "see". The manual sweep allows the operator to range back and forth across any portion of the response curve of a circuit at any desired rate. This feature is particularly useful when a frequency counter is used to measure the exact frequency of some point along the response curve, or when it is desirable to retain a permanent record of the response curve by utilizing an X-Y recorder.

A nominally sawtooth signal of approximately 5 volts peak-to-peak, developed across a low impedance, is made available at the Sweep Out terminals, providing a signal for driving the horizontal amplifiers of an oscilloscope. This feature eliminates the necessity of using the internal sweep of the oscilloscope. Since the sawtooth developed within the Sona-Sweep is synchronized with the swept rf output, no phasing adjustments are necessary, and the sweep cannot drift out of synchronization.

1.2 FEATURES.

The Sona-Sweep Model M is designed for either bench-top operation or for mounting in a standard 19-inch relay rack. The instrument is self-contained, including the voltage regulated power supply. All operating controls are clearly marked to indicate the function of the control. Operating controls and terminals are mounted on the front panel and are easily accessible.

Since most r-f detectors do not operate properly when employed to detect audio signals, a specially designed audio detector, which may be used when the instrument is being operated on the Read Direct band, is incorporated within this instrument. The input and output terminals of the detector are mounted on the front panel so that the detector may be patched into the system or left out, as desired. A gain control is included within the detector. This feature is useful when observing marker pulses on the audio sweep where the pulses may be lost in the valleys of the audio signal.

Up to nine fixed, pulse-type markers are available (as specified by the customer). These may be switched in individually or in groups. A variable pulse-type marker may be used by employing an external c-w signal generator in conjunction with the Sona-Sweep Model M. These marks are made available at a front panel terminal. This permits the use of a marker by-pass system, wherein the frequency markers are applied directly to the vertical input terminals of the oscilloscope instead of being passed through the circuit under test. Thus, frequency markers are provided that are independent of the characteristics of the circuit being examined.

A calibrated, precision, stepped attenuator providing up to 59 db attenuation is incorporated. By use of this attenuator, a quantitative amplitude measurement, in terms of db level, may be made directly on a C.R.O. A gain control provides an additional continuously variable 6 db attenuation allowing the selection of any output level within a 65 db range.

The Sona-Sweep Model M is ruggedly constructed and is designed to provide trouble-free service over long operating periods. A fan and grill provide ample air circulation. The built-in power supply is designed for 117-volt operation (234-volt operation on request).

1.3 SPECIFICATIONS.

Center Frequency Range: 20 cps to 200 kc.

Sweep Width: Three ranges;
20 cps to 2 kc
200 cps to 20 kc
2 kc to 200 kc

Sweep Output and Repetition Rates: Sawtooth for horizontal deflection of scope trace. Low impedance output, 5 volts peak-to-peak (approx.). Nominally logarithmic sweep available on all sweep widths at any rate.

a. Fixed at 30 cps in line-lock mode.

b. Three continuously variable ranges;
0.2 cps to 1.0 cps
1.0 cps to 5.0 cps
5.0 cps to 25 cps

c. Manual sweep.

Output Level: 5 volts rms into approximately 600 ohms.

Flatness: ±0.5 db over widest sweep.

Calibrated CW Output: 20 cps to 200 kc.

Built-in Attenuator: Switchable steps; 3 db, 6 db, 10 db, 20 db, 20 db, and 6 db variable.

Markers (optional): Up to 9 crystal-stabilized, pulse-type markers at customer specified frequencies. A continuously variable pulse-type marker may be developed by using a signal generator having an output amplitude of approximately 0.7 volts rms.

Internal Detector: Indicates the response envelope of the tested circuit when the Model M is operating at 20 kc or 200 kc sweep widths.

Power Requirements: 220 watts, 117 volts (±10%), 60 cps, B+ electronically regulated.

Dimensions: 19" x 16" x 11".

1.4 EQUIPMENT SUPPLIED.

The standard Sona-Sweep Model M is mounted in a metal cabinet and is shipped complete with built-in power supply. Crystals and diodes for the optional pip circuits are installed only when specifically ordered by the customer. Other auxiliary equipment and interconnecting cables referred to in this manual are not supplied.

SECTION II
INSTALLATION

2.1 GENERAL INSTRUCTIONS.

As soon as the Sona-Sweep Model M is received, it should be visually inspected to determine that the instrument was not damaged during shipment. Any damage should be reported immediately to the carrier and Kay Electric Company, or its representative in the area.

Installation presents no particular problem since the instrument is self-contained, including the power supply, and is designed for either bench-top operation or for mounting in a standard 19-inch relay rack. It is recommended that sufficient space be allotted to avoid obstruction of the ventilating grill-work. Space should also be provided for the auxiliary equipment. The operating area selected should be as free as possible from vibration due to the presence of machinery or other sources of vibration. Extreme variations of ambient temperature and an environment having excessive humidity should also be avoided. Observation of these precautions will result in the user realizing optimum performance of the equipment.

2.2 INTERCONNECTION DATA.

Interconnections between the Sona-Sweep Model M, the associated equipment, and the circuit being investigated will be determined, at least partially, by the requirements of the circuit being investigated. All leads should be kept to minimum length consistent with the placement of the equipment on the bench. Detailed information concerning installation is contained in the operation section.

SECTION III
FUNCTION OF CONTROLS AND TERMINALS

3.1 FRONT-OF-PANEL CONTROLS.

CONTROL	POSITION	FUNCTION
Power ON - OFF Switch S-19	ON	When S-19 is set to the ON position, power-line voltage is applied to power transformer T-1 in the power-supply section, furnishing filament and regulated voltages to all circuits, activating the instrument for operation.
	OFF	In OFF position, the instrument is completely de-activated.
SWEEP RATE Pot R-189	Variable	The SWEEP RATE potentiometer is used to adjust the sweep rate of the sawtooth voltage appearing at SWEEP OUTPUT terminal J-1. The SWEEP RATE control is effective only on the three variable rate positions of the Sweep Selector (S-1).
SWEEP SELECTOR Switch S-1	LINE LOCK 5 - 25 1 - 5 .2 - 1 MANUAL	This 5-position rotary switch is used to select the operating mode of the sweep generator. In LINE LOCK position, the output is swept linearly at line frequency. In the three variable sweep rate positions, the output is swept linearly at a rate determined by the setting of the SWEEP SELECTOR and SWEEP RATE controls. In MANUAL sweep position, the MANUAL SWEEP pot (R-65) is used to set the output frequency and C.R.O. X-axis deflection on a d-c basis.
SWEEP WIDTH Pot R-29	Variable	This potentiometer is used to vary the sweep width within the limits of the ranges selected by the FUNCTION SELECTOR. These ranges are: 20 cps to 2 kc, 200 cps to 20 kc, 2 kc to 200 kc.
FUNCTION SELECTOR	CW 2 kc 20 kc 200 kc	This control is used to select the operating mode of the instrument.

CONTROL	POSITION	FUNCTION
LOG SWEEP - LINEAR SWEEP Switch (S-13)	LOG SWEEP LINEAR SWEEP	When S-13 is set to LOG SWEEP position, the regular sawtooth signal, used to vary the frequency of the sweep oscillators, is transformed in the cathode circuit of cathode follower V-3, to a logarithmic voltage change, causing the oscillator in use to undergo a nominally logarithmic change in output frequency. With S-13 in the LINEAR SWEEP position, the regular sawtooth voltage is used to linearly vary the oscillator output frequency.
MANUAL SWEEP Pot R-65	Variable	This control is used to manually vary the output frequency within the same range covered by the internal sweep generator for given settings of the FUNCTION SELECTOR and BAND SELECTOR, and also provides a d-c output at the SWEEP OUTPUT terminals for horizontal deflection of the scope trace.
ZERO ADJ. Pot R-74	Variable	The ZERO ADJ control is used to make small adjustments of center frequency to compensate for component aging.
Attenuator Switches S-14 thru S-18	Stepped	These toggle switches permit insertion of additive, stepped attenuation of 3 db, 6 db, 10 db, 20 db, 20 db ahead of SWP OSC OUTPUT jack J-6.
OUTPUT LEVEL Pot R-157	Variable	This control provides a 6-db variable increment of attenuation in addition to the stepped attenuation.
PIP ADJ Pot R-131	Variable	The PIP ADJ control is used to establish the amplitude of the marker pulses applied to Schmitt Trigger V-14. Proper setting for this control is the point at which all the marker pips just appear and no multiple firing occurs.
PIP LEVEL Pot R-155	Variable	The amplitude of the marker pips appearing on the scope screen can be varied from zero to approx. 5 volts, according to the setting of this control.

CONTROL	POSITION	FUNCTION
BAND SELECTOR Switch S-3	10 positions	This control is used to select the 20-kc segment of the frequency coverage to be used when the instrument is operated with the FUNCTION SELECTOR in the 20 kc position. (LOG-LINEAR switch must be in LINEAR position). The READ DIRECT position covers 20 cps to 20 kc. The next nine positions add 20 kc per step, i.e., position 2 (add 20 kc) sweeps 20 to 40 kc; position 3 (add 40 kc) sweeps 40 to 60 kc, etc., up to add 180 kc, where sweeps cover 180 to 200 kc. When the instrument is being operated in either the 2-kc or the 200-kc function, the BAND SELECTOR is left in the READ DIRECT position.
CENTER FREQUENCY Capacitor C-23	Variable	This control is used to vary the center frequency of the sweep within the range determined by the BAND SELECTOR. It is also used to vary the c-w output frequency when the FUNCTION SELECTOR is in the CW position. When operating in the c-w function, only the lower scale (0 to 20) of the Center Frequency dial is used.
MARKER Switches S-4 thru S-12	Individually switched	The marker switches permit selection of appropriate frequency markers for the swept band in use. Markers are generated when one or more switches are in the up position.
DET GAIN Pot R-104	Variable	This control is used to vary the detector gain when the BAND SELECTOR is set to the READ DIRECT position (0 - 20 kc).

3.2 FRONT-OF-PANEL TERMINALS.

TERMINAL	FUNCTION
SWEEP OUTPUT J-1	A sawtooth voltage, synchronized with the sweeping output, is available at this terminal. The sawtooth voltage is used as a horizontal deflection voltage for the C.R.O. At slow sweep rates, the C.R.O. should be switched to d-c amplifier operation.
PIP OUTPUT J-5	Fixed and variable, crystal-controlled frequency-identifying pulses, generated within the Sona-Sweep, are available at this terminal.
EXT OSC INPUT J-4	A 20-cps to 200-kc signal, obtained from an auxiliary signal generator, may be applied to this terminal to develop a variable, pulse-type frequency marker.

TERMINAL	FUNCTION
SWP OSC OUTPUT J-6	The swept or c-w signal of up to 5 volts into 600 ohms is available at this terminal, or attenuated up to 62 db.
DET INPUT J-2	The signal output from the device being tested is applied to this terminal for the development of an envelope-type display on the C.R.O. screen.
DET OUTPUT J-3	The detected signal of the tested device is available at this terminal for application to the Y-axis input terminal on the C.R.O.

3.3 INTERNAL CONTROLS (All located on left side of chassis).

CONTROL	POSITION	FUNCTION
SYNC LOCK Pot R-9	Variable	This potentiometer, is used to synchronize sync generator V-1 to the a-c power-line frequency.
30 CPS ADJ Pot R-192	Variable	This potentiometer is used to set the sweep generator to a 30-cps rep rate, when the SWEEP SELECTOR is set to LINE LOCK position, permitting sync generator V-2 to lock at one-half line frequency.
PIP GEN ADJ Pot R-150	Variable	The firing point of Pip Generator V-15 is established by this control.
PIP AMPL ADJ R-139	Variable	The operating point of Trigger amplifier V-13 may be adjusted with this control for optimum operation of the marker generator circuits.
LIN ADJ BREAK Pot R-83	Variable	This control is used to set the voltage level at which the slope of the sweep waveform is altered to improve sweep linearity on 20 kc sweeps.
LIN ADJ SLOPE Pot R-81	Variable	The slope of the sweep waveform may be further adjusted to optimize linearity by varying this control on 20 kc sweeps.
SWEEP OUTPUT ZERO Pot R-195	Variable	This control centers the sweep output voltage with respect to ground.
200 KC LIN ADJ Pot R-60	Variable	This control is used to set the voltage level at which the slope of the sweep waveform is altered to improve sweep linearity on 200 kc sweeps.

SECTION IV
OPERATION

4.1 GENERAL.

The Sona-Sweep Model M may be used to determine the bandpass characteristics of receivers, tuners, amplifiers, networks, and other devices in the audio and low r-f ranges. When used with an oscilloscope, a presentation of the response curve of the circuit being investigated is displayed on the C.R.O. The flat output (±0.5 db over widest sweep) insures the development of an accurate response curve. The sweep output provides a sawtooth which is synchronized with the sweeping output, eliminating the necessity of using the internal sweep of the oscilloscope. A blanking signal turns off the output of the buffer amplifier (V-6) during C.R.O. retrace time leaving a zero voltage baseline on the oscilloscope; thus the output of the response curve can be measured directly.

4.2 ZEROING THE CENTER FREQUENCY DIAL.

Normal component aging and other variable factors may change the calibration of the CENTER FREQUENCY dial. An adjustment is provided to correct for small changes in calibration due to these effects. In order to insure proper calibration of the CENTER FREQUENCY dial the following procedure should be performed each time the instrument is to be used.

Step 1. Turn power ON-OFF switch to ON.

Step 2. Connect SWP OSC OUTPUT terminal to vertical input terminal of scope.

Step 3. Connect SWEEP OUT terminal to horizontal input terminal of scope.

Step 4. Set SWEEP SELECTOR to LINE LOCK.

Step 5. Set FUNCTION SELECTOR to 2 KC.

Step 6. Set LOG-SWEEP - LINEAR SWEEP switch to LINEAR SWEEP.

Step 7. Set SWEEP WIDTH control fully counterclockwise.

Step 8. Set BAND SELECTOR to READ DIRECT.

Step 9. Set CENTER FREQUENCY to zero.

Step 10. Set OUTPUT LEVEL fully clockwise.

Step 11. Switch all attenuation out.

Step 12. Vary ZERO ADJ control until zero beat appears on scope screen.

4.3 INTERCONNECTIONS.

Basic interconnections for using the Sona-Sweep Model M and associated equipment to investigate a circuit are shown in Fig. 4.1. Refer to Section 2.2 for general information concerning interconnections. Use of the instrument for other than the standard use may call for modifications in the interconnection diagram and will be left to the discretion of the customer. Kay Electric Company and its representatives are available for information regarding the application of this instrument.

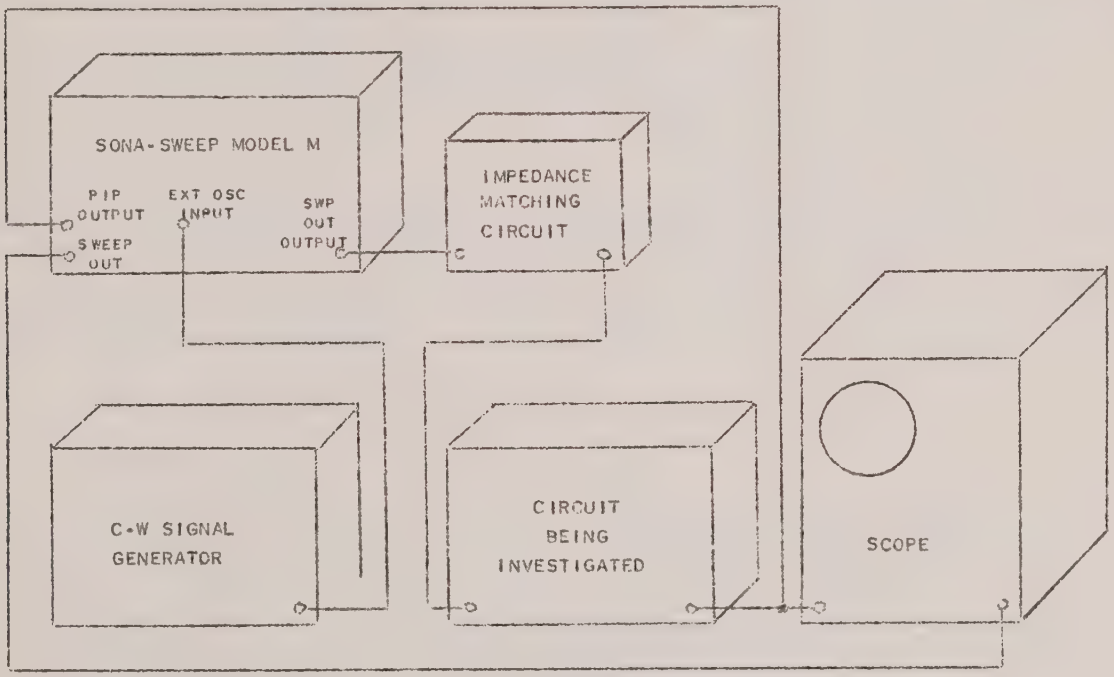


Fig. 4.1 Basic Interconnection of equipment, Sona-Sweep Model M.

4.4 GENERAL OPERATING PROCEDURE.

A step-by-step operating procedure is provided here as a guide for general application. If maximum utility is to be obtained from the instrument, deviations from this procedure will be necessary, according to the measurements being made and the type of equipment being investigated. The operator should become familiar with the function of all operating controls.

Step 1. Check calibration of CENTER FREQUENCY dial. (See Section 4.2.)

Step 2. Interconnect equipment as shown in Fig. 4.1.

Step 3. Set SWEEP SELECTOR to LINE LOCK.

Step 4. Set BAND SELECTOR to the band which contains the frequencies within the passband of the circuit being investigated.

Step 5. Set CENTER FREQUENCY control to the center frequency of the passband of the circuit being investigated.

Step 6. Set LOG SWEEP - LINEAR SWEEP switch to LINEAR SWEEP.

Step 7. Set FUNCTION SELECTOR and SWEEP WIDTH control to provide a sweep width approximately three times the width of the passband of circuit being investigate

Step 8. Adjust the OUTPUT LEVEL control and attenuator to provide a convenient vertical deflection of the signal shown on the C.R.O.

Step 9. Turn PIP LEVEL control to about the center of its range.

Step 10. Vary the PIP ADJ control to produce a single stable pip for each marker being energized (the greatest marker accuracies are obtained when this control is set to the point which just provides all desired markers).

Step 11. Readjust PIP LEVEL control to provide markers of sufficient amplitude for viewing on scope screen.

4.5 CW OPERATION.

This instrument may be used as a c-w generator by setting the FUNCTION SELECTOR switch to CW position. The output frequency is controlled by the BAND SELECTOR switch and the CENTER FREQUENCY control. The frequency is read directly on the center frequency dial, using the proper additive factor as indicated by the BAND SELECTOR dial. Only the lower scale (0-20) of the center frequency dial is used. The amplitude of the output signal may be varied with the OUTPUT LEVEL control and the step attenuator The c-w output is available at the SWP OSC OUTPUT terminals.

4.6 VARIABLE REPETITION RATES.

Variable repetition rates between 0.2 and 25 cps in three ranges are provided, with either linear or logarithmic sweeps. The variable repetition rates are made available by setting the SWEEP SELECTOR switch to one of the three variable repetition rate ranges. The SWEEP RATE control is then adjusted until the desired repetition rate, within the range determined by the setting of the SWEEP SELECTOR switch, is being produced. The repetition rate selected should be fast enough to retain as much of the pattern as possible on the oscilloscope, while still maintaining the correct response curve. A long persistent cathode-ray tube in the oscilloscope is desirable for proper pattern retention when using the slow sweep rates. The horizontal amplifiers of the scope should be set for d-c operation.

The variable repetition rates are useful when observing circuits exhibiting sharp variations in response. In these cases, the slower repetition rates will show the sharp variations which a faster repetition rate may not "see". Another

advantage of the variable repetition rate becomes apparent when a circuit exhibiting 60-cps hum is being examined. When such a circuit is being swept at a harmonic or a submultiple of 60 cps, a distorted response curve is produced.

4.7 MANUAL SWEEP.

The manual sweep is useable with both linear and logarithmic sweeps. This function is obtained by turning the SWEEP SELECTOR switch to the MAN position. The output frequency of the Sona-Sweep Model M may now be varied on either side of the frequency determined by the setting of the CENTER FREQUENCY control by adjusting the MANUAL SWEEP control. The frequency range of the MANUAL SWEEP control depends upon the settings of the FUNCTION SELECTOR switch and the SWEEP WIDTH control.

The manual sweep feature enables the operator to range back and forth across any portion of the response curve of a circuit at a repetition rate determined only by the speed at which the MANUAL SWEEP control is rotated. If it is desired to determine the exact frequency of a particular point on the response curve, one may vary the MANUAL SWEEP control until this point is determined and then read the frequency directly on a counter. Another advantage of the manual sweep concerns the use of X-Y recorders. The sweep rate may be kept slow enough, by using the manual sweep, to facilitate the use of an X-Y recorder, thus developing a permanent record of the response of the circuit being investigated. This record may be kept for a minute inspection of the response characteristics, or for comparison with another record taken at a later time.

4.8 LOGARITHMIC SWEEP.

Logarithmic sweep may be used with all available sweep widths, at any repetition rate. In this mode of operation, the lower end of the sweep is expanded while the upper end is contracted, giving the advantage of a narrow sweep at the lower end while still displaying the complete passband of the circuit being investigated. This feature is useful when examining the low-frequency end of audio circuits where the output may tend to "roll-off", or rise.

The logarithmic sweep is operated by setting the LOG SWEEP - LINEAR SWEEP switch to the LOG SWEEP position. The SWEEP WIDTH control should be set to its maximum clockwise position for best results. The CENTER FREQUENCY control should be set to that position which will provide proper spread of the output signal. The remainder of the controls are operated in the same manner as they would be when operating with the linear sweeps.

4.9 AUDIO DETECTOR.

Since most detectors do not produce a flat output when employed at low frequencies, the Sona-Sweep Model M incorporates its own detector which may be used when the instrument is being operated on the READ DIRECT band and the FUNCTION SELECTOR switch is set to either 2 KC, 20 KC, or 200 KC. The output from the circuit being investigated is connected to the DET INPUT terminal and the output is taken from the DET OUTPUT terminal. The amplitude of the signal going into the detector may be varied by use of the DET GAIN control, thus providing a means of varying the amplitude of the signal available at the DET OUTPUT terminal. Maximum output for an undistorted response is 1-volt peak.

4.10 MARKERS.

Up to nine crystal-controlled, pulse-type markers are provided, as specified by the customer. Since the PIP OUTPUT terminals are connected to the vertical input terminals of the scope, operation of the markers does not depend on the frequency characteristics of the circuit, nor will the marker pulses affect the response of the circuit being investigated. Markers may be used either singly or in groups. Operation of the markers is discussed in Section 4.4.

A variable pulse-type marker may also be developed by using an external c-w signal generator having an output of about 0.7 volt rms. When the c-w generator is connected to the EXT OSC INPUT terminal a variable marker signal is available at the PIP OUTPUT terminals.

When operating the Model M on the READ DIRECT band, the response shown on the oscilloscope will appear as a series of sine waves increasing in frequency. If marker pulses are provided on this band, the pulses will appear along the sinusoidal curves and, unless the pulses happen to fall at the positive peaks of the curve they may be difficult to see, if not completely lost. In this case it may be advisable to make use of the internal audio detector (see Section 4.9).

4.11 ATTENUATOR.

The accurate, calibrated, stepped attenuator is very useful for the measurement of voltage levels. By using the attenuator, a reference can be made on the oscilloscope of voltage levels below the average signal level in terms of db, without the necessity of using external measuring devices. Such useful information as the "3 db down" point can be obtained directly from the instrument by using the precision step attenuator. A 6-db variable attenuation control is also provided to allow the operator to select any desired intermediate output level within the range of the instrument.

SECTION V
CIRCUIT DESCRIPTION

5.1 INTRODUCTION.

This section is devoted to a general discussion of the Sona-Sweep Model M circuits. While a working knowledge of the circuitry is not essential to operate the instrument, such knowledge is useful to the service technician and to the discriminating user desiring to exploit the instrument's versatility to the fullest extent.

5.2 OVER-ALL CIRCUIT ANALYSIS.

Analysis of the circuitry can begin with the sweep generating circuits. Here, timing pulses and sawtooth voltages are generated for later use in developing the frequency sweeps. These circuits may be operated in any one of three basic modes by adjustment of the panel controls to the desired mode as indicated in the illuminated dial windows. A block diagram of the circuitry is furnished in Fig. 5.1.

Sync generator V-1 operates as a Schmitt trigger controlled by the line frequenc and generates a train of synchronizing pulses. These pulses are used to trigger sweep generator V-2 at a 30-cps rate when the Sweep Selector is in the Line Lock position. The sweep generator operates as a Phantastron, producing a sawtooth output which is locked at 30 cps when the Sweep Selector is in the Line Lock position, and is variable when the Sweep Selector is in one of the three variable positions. The output of the sweep generator is passed to sweep out inverter amplifier C-1, which provides a low impedance source of sawtooth voltage to drive the horizontal amplifier of the scope. The output of the sweep generator is also used to turn off the output of buffer-amplifier V-6 during retrace time.

Another output of sweep generator V-2 goes to cathode follower V-3, which serves to isolate the r-f circuits. When operating in the 2-kc or 20-kc modes, the sawtooth at pin 8 of V-3 is fed through R-33 and R-44 to voltage-variable capacitor C-17, and to crystal Y-1 in the cathode circuit of sweep oscillator V-4. For operation in the 200-kc mode, this same sawtooth signal is fed through C-119 to voltage-variable capacitors C-117 and C-118, in the plate circuit of the 200-kc sweep oscillator, V-18. The sawtooth signal serves to vary the frequency of the oscillator around its characteristic frequency.

When the Function Selector is in the CW position, no sawtooth is applied to the oscillator and they operate at their natural frequencies. When the Sweep Selector is in the MAN position, the voltage across the voltage-variable capacitors is controlled manually.

The output of the oscillators is fed to swept buffer-amplifier V-19, which serves to isolate the oscillators, and into a modulator (D-2 thru D-5) where it is mixed with the signal generated by tunable c-w oscillator V-5. The output of this modulator is filtered to remove all but the difference frequencies and passed to buffer-amplifier V-6.

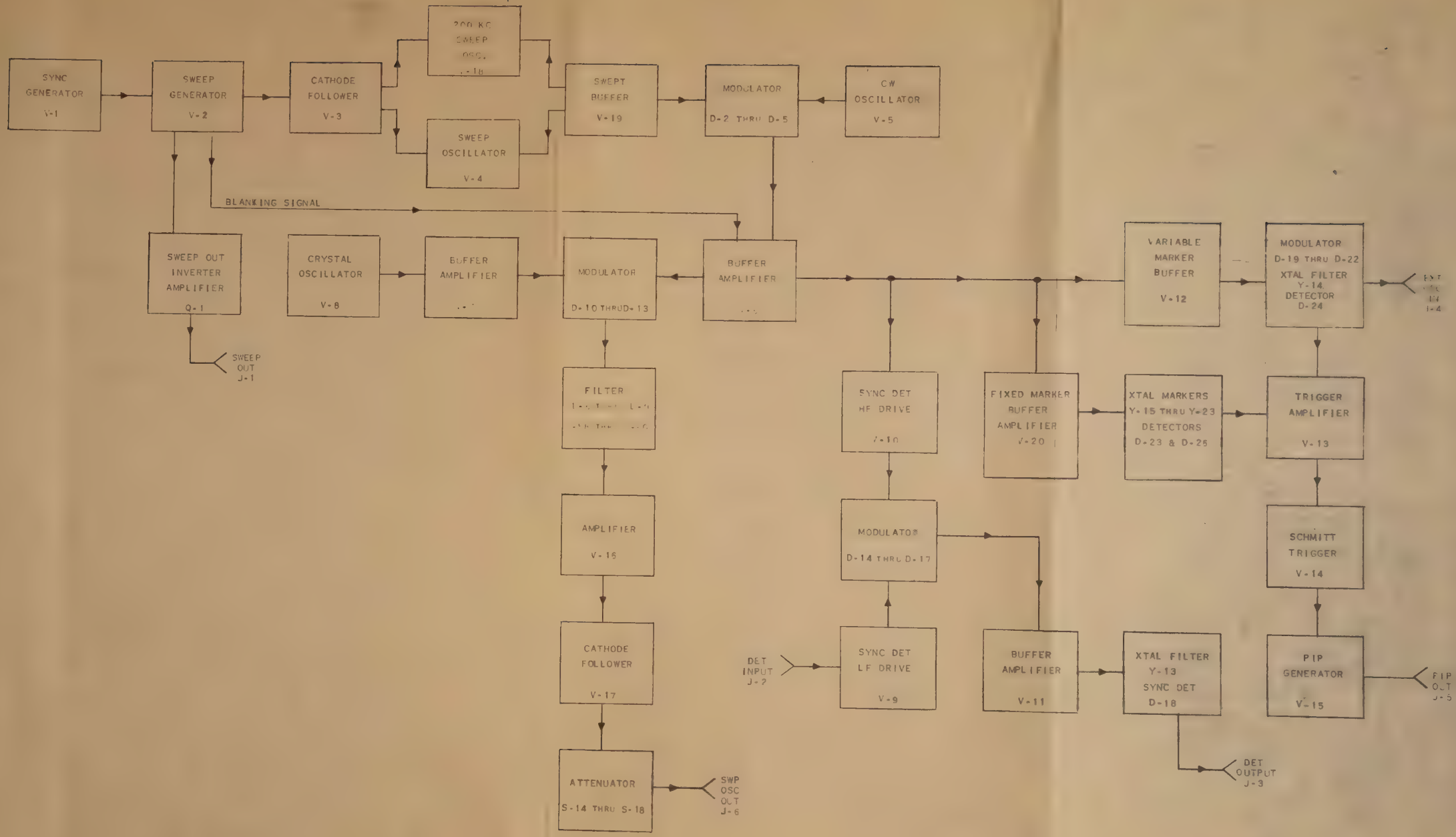


Fig. 5.1, FUNCTIONAL BLOCK DIAGRAM, SONA-SWEEP M.

Four outputs are taken from buffer-amplifier V-6; one going to the variable marker circuits, one to the fixed marker circuits, one to the detector circuits, and one to the output modulator (D-10 thru D-13).

The signal that is fed to the output modulator is mixed with the c-w signal from crystal oscillator V-8. The output is filtered to remove all but the difference frequencies, then amplified and sent through cathode follower V-17 and the attenuator to the SWP OSC OUTPUT terminal.

The second signal from buffer-amplifier V-6 is fed to variable marker buffer-amplifier V-12, and to a modulator (D-19 thru D-22) where it is mixed with the signal from an external c-w oscillator. The difference frequency is applied to input of trigger amplifier V-13. A third signal from V-6 is fed to the fixed marker buffer-amplifier V-20, and then to the crystal marker circuits where it is used to energize the marker crystals. The pulses generated in the crystal marker circuits are applied to the input of trigger amplifier V-13.

Pulses which appear at the input of trigger amplifier V-13 are amplified and fed to Schmitt trigger V-14, which generates a sharp, square pulse for each pulse applied to its input. The pulses from the output of the Schmitt trigger serve to trigger pip generator V-15 so that a sharp, single pip appears at the PIP OUTPUT terminals for every marker pulse applied to the input of the marker system.

A fourth signal from buffer-amplifier V-6 is applied through the sync detector HF drive (V-10) to a modulator (D-14 thru D-17). The second input to this modulator comes from the DET INPUT through the sync det i-f drive (V-9). These signals are mixed in the modulator and the difference frequency is applied to buffer-amplifier V-11 and the sync detector, where the signal is detected and made available at the DET OUTPUT terminals.

SECTION VI
MAINTENANCE

6.1 INTRODUCTION.

This section covers recommended procedures for troubleshooting, alignment, and inspection of the Sona-Sweep Model M. A list of required test equipment is included. An inspection procedure for quickly inspecting the equipment for incoming inspection, or for periodic maintenance inspections is also included, as well as a complete alignment procedure.

6.2 MAINTENANCE SUGGESTIONS.

The use of a cathode-ray oscilloscope is recommended for signal tracing through the circuitry to locate circuit malfunctions. A detector probe is required when signal tracing through the r-f circuits and a suitable detector is described in Fig.

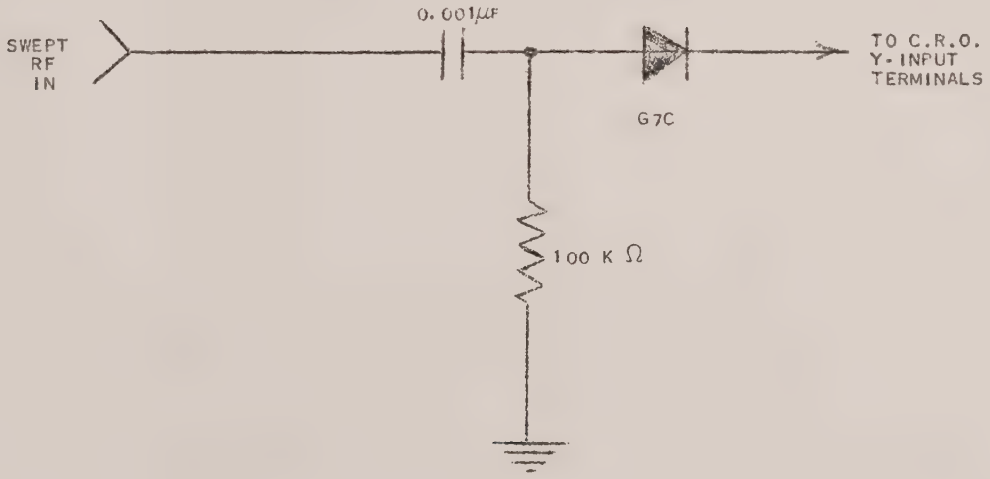


Fig. 6.1, Schematic, Detector Probe.

6.3 INSPECTION PROCEDURE.

This procedure provides a complete operational inspection of the instrument and may be completed without removing the instrument from its cabinet. The inspection outlined here may be used as an acceptance check, or for a periodic check-out of the Sona-Sweep Model M. The operator may also find this procedure helpful in cases where he knows something is wrong with the test set-up, but is not sure which unit is malfunctioning. The following equipment is required.

VTVM, (RCA Senior VoltOhmyst), or equivalent.

Oscilloscope, (Tektronix Type 503), or equivalent.

C-W Signal Generator, with a frequency range between 20 cps and 200 kc.

Detector Probe, (See Fig. 6.1).

Wave trap box, containing the following wave traps:
200 cps, 2 kc, 5 kc, 10 kc, 15 kc, 20 kc,
50 kc, 100 kc, 150 kc, and 200 kc. (See Fig. 6.2)

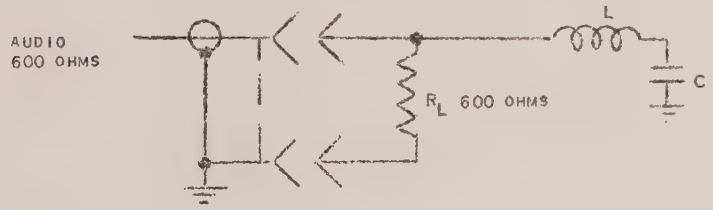


Fig. 6.2, Typical Wave Trap Schematic

FORMULAS AND TYPICAL VALUES

$$f_r = \frac{1}{2\pi\sqrt{LC}} \qquad C = \frac{1}{(2\pi)^2 f_R{}^2 L}$$

CAPACITOR IS CALCULATED FOR AVAILABLE COIL BUT SHOULD BE LARGE. ADJUSTMENT OF CAPACITY IS USUALLY EASIER THAN ADJUSTMENT OF INDUCTANCE.

f_r (RESONANT FREQ.)	L (INDUCTANCE)	C (CAPACITY, CALCULATED)
5 KC	100 MILLIHENRY	0.01013μF
10 KC	50 "	5065μμF
15 KC	37.5 "	3799μμF
20 KC	25 "	2533μμF

6.3 A. Check-out of Line Lock.

Step 1. Connect the SWEEP OUT terminals to the vertical input terminals of the scope.

Step 2. Set the horizontal sweep of the scope for a 15-cps rate (5 milliseconds/centimeter) external sync.

Step 3. Set scope sync control to line position.

Step 4. Set SWEEP SELECTOR to LINE LOCK.

(If the sweep is locked to the line, a stationary pattern will result).

6.3 B. Check-out of Variable Repetition Rates.

Step 1. Connect the SWEEP OUT terminal to the vertical input terminal of the scope.

Step 2. Set the scope controls for internal sync.

Step 3. Set the scope for d-c amplifier operation.

Step 4. Set the scope sweep rate for an appropriate time-per-division (approx. twice the Sona-Sweep Model M time per cycle, $\frac{1}{f}$).

Step 5. Observe the time interval for one cycle and compare it with the specification listed in Fig. 6.3.

Fig. 6.3, Table of data required for adjustment of the variable repetition rates.

SWEEP SELECTOR SETTING	SWEEP RATE CONTROL SETTING	FREQUENCY (CPS)	TIME PER CYCLE (SECONDS)	SELECTABLE CAPACITOR	SELECTABLE RESISTOR
VAR 5-25	maximum clockwise	greater than 25	less than 0.04	C-45	R-54
VAR 5-25	maximum counter-clockwise	less than 5	more than 0.2	C-45	R-54
VAR 1-5	maximum clockwise	greater than 5	less than 0.2	C-46	R-55
VAR 1-5	maximum counter-clockwise	less than 1	more than 1	C-46	R-55
VAR 0.2-1	maximum clockwise	greater than 1	less than 1	C-47	R-56
VAR 0.2-1	maximum counter-clockwise	less than 0.2	more than 5	C-47	R-56

6.3 C. Check-out of Center Frequency.

Step 1. Interconnect the equipment as shown in Fig. 6.4.

Step 2. Set the Sona-Sweep controls as follows:

SWEEP SELECTOR: LINE LOCK

FUNCTION SELECTOR: 20 KC

LOG SWEEP - LINEAR SWEEP: LINEAR SWEEP

BAND SELECTOR: READ DIRECT

SWEEP WIDTH: Fully counterclockwise

OUTPUT LEVEL: Fully clockwise

Attenuation: All out

Step 3. Turn CENTER FREQUENCY control to zero. Zero beat should appear on the scope screen.

Step 4. Set output frequency of signal generator at 20 kc.

Step 5. Turn CENTER FREQUENCY control to the 20-kc position. The birdie marker produced by the signal generator should appear on the oscilloscope screen.

Step 6. Check remaining bands in similar manner.

6.3 D. Check-out of Sweep Width.

Step 1. Interconnect the equipment as shown in Fig. 6.4.

Step 2. Set Sona-Sweep controls as follows:

SWEEP SELECTOR: LINE LOCK

FUNCTION SELECTOR: 20 KC

LOG SWEEP - LINEAR SWEEP: LINEAR SWEEP

CENTER FREQUENCY: 20 KC

BAND SELECTOR: READ DIRECT

SWEEP WIDTH: Fully clockwise

OUTPUT LEVEL: Fully clockwise

Attenuation: All out

Step 3. Vary the frequency control on the external c-w signal generator until the marker appears at the extreme left-hand side of the pattern. Record this frequency.

Step 4. Turn the frequency control on the external c-w signal generator until the marker appears at the extreme right-hand side of the pattern. Record this frequency. The difference between these two frequencies is the sweep width.

Step 5. Check the 2 kc and 200 kc sweep in a similar manner.

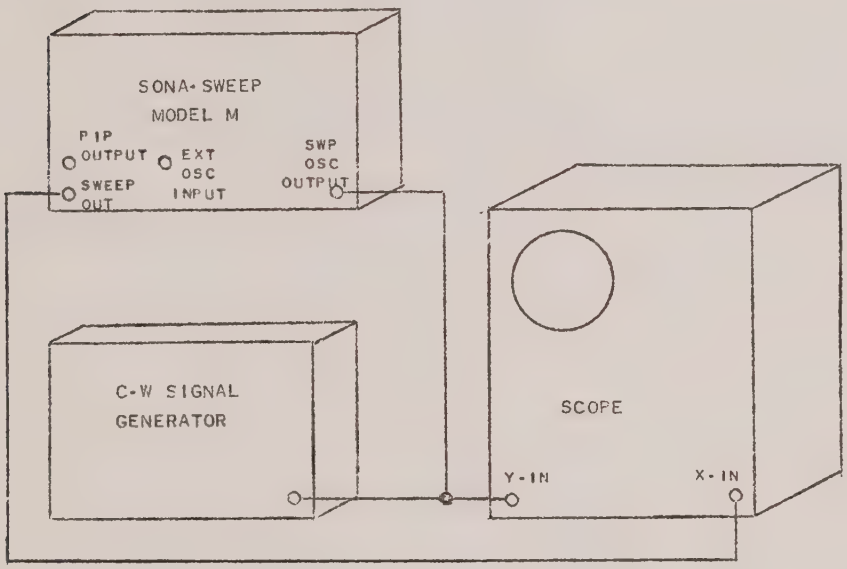


Fig. 6.4, Equipment Interconnections for Checking Sweep Width and Center Frequency, Sona-Sweep Model M. (If the output impedance of the signal generator differs substantially from 70 ohms, an impedance matching device should be used).

6.3 E. Check-out of Linearity.

Step 1. Interconnect the equipment as shown in Fig. 6.5.

Step 2. Set Sona-Sweep controls as follows:

SWEEP SELECTOR: LINE LOCK

FUNCTION SELECTOR: 20 KC

LOG SWEEP - LINEAR SWEEP: LINEAR SWEEP

BAND SELECTOR: READ DIRECT

SWEEP WIDTH: Fully clockwise

OUTPUT LEVEL: Fully clockwise

Attenuation: All out

Step 3. Turn the CENTER FREQUENCY control until the zero beat appears at the extreme left-hand side of the scope pattern.

Step 4. Activate the 5-kc, 10-kc, 15-kc, and 20-kc wave traps.

Step 5. See that the zero beat and the marks produced by the wave traps divide the trace (as seen on the oscilloscope screen) into four equal segments.

Step 6. Turn the FUNCTION SELECTOR to 200 KC and repeat this procedure. Repeat with FUNCTION SELECTOR at 2 KC.

Step 7. Repeat this procedure with the LOG SWEEP - LINEAR SWEEP switch at LOG SWEEP.

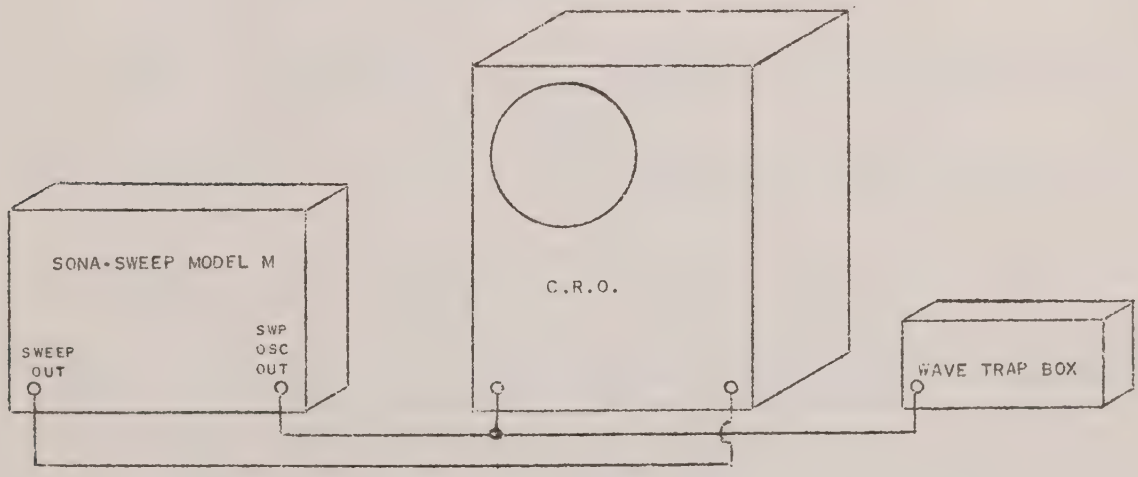


Fig. 6.5, Equipment Interconnections for Checking Linearity, Sona-Sweep Model M. (A switching arrangement should be provided so that any one, or combination of wave traps may be selected).

6.3 F. Check-out of Markers.

Step 1. Connect the SWP OSC OUTPUT terminal to the vertical input terminal of the scope.

Step 2. Connect the SWEEP OUT terminal to the horizontal input terminal of the scope.

Step 3. Connect the PIP OUTPUT terminal to the vertical input terminal of the scope.

Step 4. Connect output of the external signal generator to EXT OSC INPUT terminal.

Step 5. Set Sona-Sweep controls as follows:

SWEEP SELECTOR: LINE LOCK

FUNCTION SELECTOR: 20 KC

LOG SWEEP - LINEAR SWEEP: LINEAR SWEEP

BAND SELECTOR: READ DIRECT

PIP LEVEL: Center of range

SWEEP WIDTH: Fully clockwise

OUTPUT LEVEL: Fully clockwise

Attenuation: All out

Step 6. Turn the CENTER FREQUENCY CONTROL until the zero beat appears at the extreme left-hand side of the scope pattern.

Step 7. Activate the desired markers by setting appropriate marker switches to ON position (up).

Step 8. Vary the PIP ADJUST control until a single, sharp, stable pip appears for each marker crystal energized.

Step 9. Readjust the FUNCTION SELECTOR, CENTER FREQUENCY control, BAND SELECTOR and SWEEP WIDTH control to successively display each portion of the swept output for which crystal markers are provided and repeat this marker check-out for all bands on which there are markers.

Step 10. To check the variable marker, tune the signal generator across the frequency range displayed on the scope and see that a marker pip is produced by the external oscillator.

Note:- If there is only a small frequency difference in the fixed markers (i.e., if the markers appear closely spaced on the sweep trace, as seen on the oscilloscope screen), it may be necessary to back off the SWEEP WIDTH control from its full clockwise position. The individual crystal arrangement will determine the setting.

6.3 G. Check-out of Audio Detector.

Step 1. Connect the SWP OSC OUTPUT terminal to the vertical input terminal of the scope.

Step 2. Connect the SWEEP OUT terminal to the horizontal input terminal of the scope.

Step 3. Set the Sona-Sweep controls as follows:

SWEEP SELECTOR: LINE LOCK

FUNCTION SELECTOR: 20 KC

LOG SWEEP - LINEAR SWEEP: LINEAR SWEEP

BAND SELECTOR: READ DIRECT

SWEEP WIDTH: Fully clockwise

OUTPUT LEVEL: Fully clockwise

Attenuation: All out

Step 4. Vary the CENTER FREQUENCY control until the zero beat appears at the extreme left-hand side of the scope pattern.

Step 5. Disconnect the SWP OSC OUTPUT terminal from the vertical input terminal of the scope.

Step 6. Set SWEEP SELECTOR to VAR 1 - 5.

Step 7. Connect the DET OUTPUT terminal to the vertical input terminal of the scope.

Step 8. Vary the DET GAIN control until the scope pattern is approximately 1-volt peak.

Step 9. Compare the detected output on the scope with the output pattern obtained in step 3 and see that they are approximately the same shape.

6.3 H. Check Output Amplitude.

Step 1. Interconnect the equipment as shown in Fig. 6.6.

Step 2. Set the Sona-Sweep controls as follows:

SWEEP SELECTOR: LINE LOCK

FUNCTION SELECTOR: CW

LOG SWEEP - LINEAR SWEEP: LINEAR SWEEP

BAND SELECTOR: READ DIRECT

SWEEP WIDTH: Fully counterclockwise

OUTPUT LEVEL: Fully clockwise

Attenuation: All out

Step 3. Vary the CENTER FREQUENCY control until the zero beat appears in the center of the scope pattern.

Step 4. Turn the CENTER FREQUENCY control until the zero beat just goes off the pattern on the left-hand side.

Step 5. See that the meter reads at least 5 volts rms.

Step 6. Turn FUNCTION SELECTOR to 20 KC.

Step 7. Turn the SWEEP WIDTH control fully clockwise.

Step 8. Range through the complete frequency output of the Sona-Sweep Model M and see that the amplitude does not vary more than ±0.5 db over the widest sweep width.

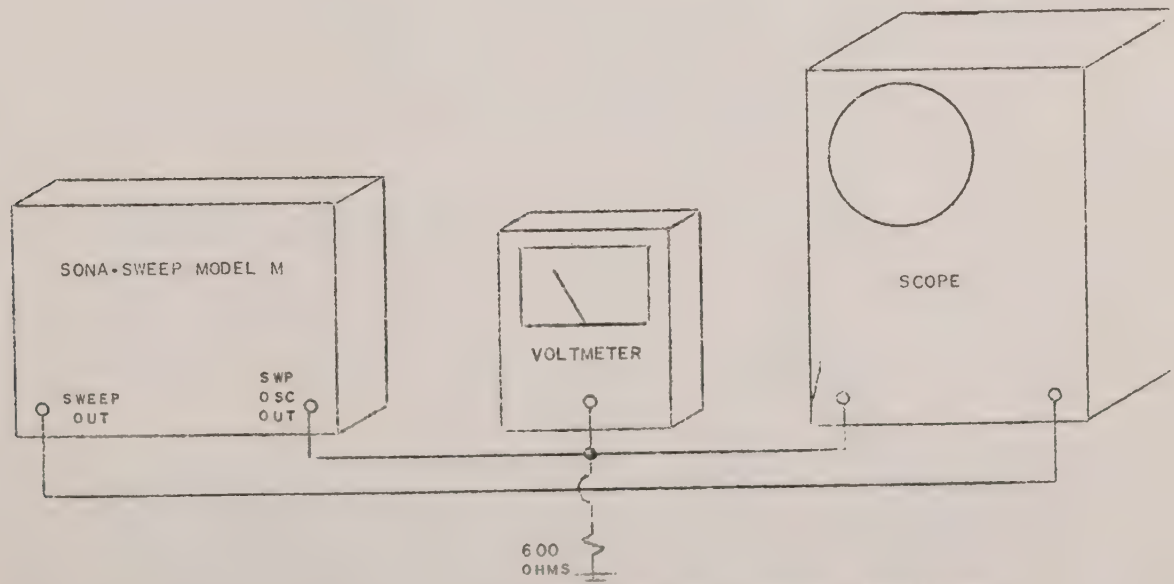


Fig. 6.6, Equipment Interconnections for Checking Output Amplitude, Sona-Sweep Model M.

6.4 ALIGNMENT AND ADJUSTMENT PROCEDURE.

This section includes instructions for aligning the Sona-Sweep Model M. If an inspection indicates that one section of the instrument is malfunctioning, it is usually possible to repair and align that section only and ignore the remainder of the alignment procedure. However, if there is any doubt, the inspection procedure should be performed in its entirety. The following equipment is required when executing this procedure:

VTVM, RCA Senior VoltOhmyst, or equivalent.

Oscilloscope, Tektronix, Type 503A, or equivalent.

Frequency Meter, Berkeley Model 7175, or equivalent.

Detector Probe (see Fig. 6.1)

Wave Trap Box, containing following wave traps:
200 cps, 2 kc, 5 kc, 10 kc, 15 kc, 20 kc,
50 kc, 100 kc, 150 kc, and 200 kc. (See Fig. 6.2)

Signal Generator, with a frequency range of 20 cps to 200 kc.

6.4 A. Adjustment of B+ Level.

Step 1. Set ON-OFF switch to ON.

Step 2. Allow 15 minutes for instrument to warm up and stabilize.

Step 3. Connect the VTVM between pin 6 of J-1 (on power supply) and chassis ground.

Step 4. Set B+ Adjust pot (R-17) to give a meter reading of 250 volts.

6.4 B. Adjustment of Line Lock.*

Step 1. Provide a connection between the SWEEP OUT terminal and the vertical input terminal on scope.

Step 2. Set C.R.O. controls for a 5 millisecond/cm sweep rate,

*Note:- If the CRO does not have a calibrated time base, connect the SWEEP OUT terminal to the Y-axis terminal and connect the output of an audio oscillator to the X-axis terminal. Lissajous patterns may then be used to measure the 28 and 30 cps repetition rates. The Lissajous patterns obtained will not be in the form of circles or ovals, but will be somewhat distorted due to the sawtooth output of the Sona-Sweep.

Step 3. Set SWEEP SELECTOR to LINE LOCK.

Step 4. Set Sync Lock pot (R-9) to either extreme of its range.

Step 5. Vary the 30 CPS Adjust pot (R-192) until one cycle covers a horizontal distance of approximately 7 centimeters on the oscilloscope screen. This will indicate a sweep repetition rate of approximately 28 cps.

Step 6. Set scope sync control to line position.

Step 7. Adjust Sync Lock pot to lock the sweep generator at a 30-cps repetition rate as indicated by a stationary pattern on the scope screen.

Step 8. Repeat steps 5 through 7 to determine the range of stable operation.

6.4 C. Adjustment of Variable Repetition Rates.

Step 1. Provide a connection between the SWEEP OUT terminal and the vertical input terminal on scope.

Step 2. Set scope for external sync and d-c amplifier operation.

Step 3. Set scope sweep rate to an appropriate time-per-division (approximately twice the Sona-Sweep M time-per-cycle).

Step 4. Observe time interval for one cycle and compare the measurement with the specification listed in Fig. 6.3.

Step 5. If the indicated frequency is less that the frequency specified when the SWEEP RATE control is set fully clockwise, decrease the value of the selectable resistor or capacitor, or both, depending upon which adjustment gives best results. Schematic designations of selectable components are shown in Fig. 6.2.

Step 6. If the indicated frequency is greater than the frequency specified when SWEEP RATE control is set fully counterclockwise, increase the value of the selectable resistor or capacitor, or both, depending upon which adjustment gives best results.

6.4 D. Adjustment of Sweep Output Zero Control.

Step 1. Connect SWEEP OUT terminal to horizontal input terminal of scope.

Step 2. Set SWEEP SELECTOR to LINE LOCK.

Step 3. Set scope for d-c operation and minimum horizontal gain.

Step 4. Position the spot in center of scope screen by means of positioning controls.

Step 5. Increase scope horizontal gain to give some convenient deflection.

Step 6. Adjust Sweep Output Zero control (R-195) to give equal horizontal deflection each side of center.

6.4 E. Adjustment of High Frequency C-W Oscillator (V-5).

Step 1. Connect a frequency meter (through a 120-ohm resistor) between one side of the secondary winding of T-13 and ground.

Step 2. Connect the VTVM between TP-2 and ground.

Step 3. Adjust the tuning slug of T-13 until the VTVM indicates a maximum negative d-c reading.

Step 4. Tune the CENTER FREQUENCY control across its entire range. The frequency meter should indicate readings between below 11.990000 mc and above 12.010000 mc. If these readings are not obtained, adjust tuning slug of L-4.

6.4 F. Adjustment of 20 KC Swept Oscillator (V-4).

Step 1. Connect a frequency meter (through a 510-ohm resistor) between one side of T-1 secondary and ground.

Step 2. Connect the VTVM between TP-1 and ground.

Step 3. Set FUNCTION SELECTOR to CW.

Step 4. Adjust the tuning slug in T-1 until the VTVM reads a maximum negative d-c voltage.

Step 5. Adjust the tuning slug in L-2 until the frequency meter indicates a reading of 13.410000.

6.4 G. Adjustment of Sweep Buffer (V-19).

Step 1. Connect the vertical input terminal of the scope, through a detector probe, across one side of T-12 secondary and ground.

Step 2. Set FUNCTION SELECTOR to CW.

Step 3. Adjust the tuning slug in T-12 to give maximum vertical deflection on scope screen.

6.4 H. Adjustment of Crystal Oscillator (V-8).

Step 1. Connect the VTVM between TP-3 and ground.

Step 2. Set BAND SELECTOR to READ DIRECT.

Step 3. Adjust C-24 until the VTVM reads a maximum negative d-c voltage.

Step 4. Tune other bands similarly. Trimmers requiring adjustment are listed in Fig. 6.7.

Fig. 6.7, Table of frequencies for crystal oscillator V-8.

BAND SELECTOR SETTING	CRYSTAL FREQUENCY (mc)	TUNING CAPACITOR
Read direct	1.4000	C-24 & C-27
add 20 kc	1.3800	C-25
add 40 kc	1.3600	C-26
add 60 kc	1.3400	C-28
add 80 kc	1.3200	C-30
add 100 kc	1.3000	C-33
add 120 kc	1.2800	C-35
add 140 kc	1.2600	C-37
add 160 kc	1.2400	C-38
add 180 kc	1.2200	C-40

6.4 I. Alignment of 20 KC Swept Oscillator (V-4).

Step 1. Interconnect equipment as shown in Fig. 6.5.

Step 2. Connect frequency meter between either side of T-13 secondary and ground.

Step 3. Set Sona-Sweep controls as follows:

LOG SWEEP - LINEAR SWEEP: LINEAR SWEEP

SWEEP SELECTOR: LINE LOCK

FUNCTION SELECTOR: 20 KC

BAND SELECTOR: READ DIRECT

SWEEP WIDTH: Fully clockwise

OUTPUT LEVEL: Fully clockwise

Attenuation: All out

Step 4. Tune CENTER FREQUENCY control until frequency meter indicates 12.0000 mc.

Step 5. Adjust the tuning slug in L-2 until zero beat appears at left-hand side of trace.

Step 6. Disconnect the vertical input terminal of the scope from the SWP OSC OUTPUT terminal and connect it between either side of C-15 and ground.

Step 7. Establish a reference for the vertical deflection of the scope and note the deflection caused by the input signal.

Step 8. Disconnect the vertical input terminal of scope from C-15 and connect it between either side of C-16 and ground.

Step 9. Adjust the ZERO ADJ control so that the vertical deflection shown on the scope indicates an amplitude no more than 2.0 volts above the reading obtained in Step 7.

Step 10. Disconnect the vertical input terminal of scope from C-16 and reconnect it to the SWP OSC OUTPUT jack.

Step 11. By successive alternate adjustments of the Linearity Adjust Break control (R-83), Linearity Adjust Slope control (R-81), L-2, and ZERO ADJ control, the sweep width should be set to slightly greater than 20 kc with equal spacing between the zero beat and the 5, 10, 15, and 20-kc marks produced by the wave traps.

Note:- An attempt should be made to adjust the sweep so that, when the SWEEP WIDTH pot is turned fully counterclockwise and the variable c-w oscillator (V-5) is set to 12.000000 mc, the output frequency is being swept around 10 kc. Under these conditions, when the SWEEP WIDTH control is reset to its maximum clockwise position, both the zero beat and the 20-kc point of the sweep should be visible.
It is also necessary that, with the SWEEP WIDTH control at its maximum clockwise position, the CENTER FREQUENCY control be capable of shifting the output frequency over a range which will permit the appearance of the zero beat before the extreme counterclockwise position is reached. Conversely the 20-kc point should appear before the extreme clockwise position is reached.

6.4 J. Adjustment of Buffer Amplifiers (V-6 & V-7).

Step 1. Provide a connection between the vertical input terminal of the scope and either side of T-3 secondary and ground.

Step 2. Connect the SWEEP OUT terminal to the horizontal input terminal of scope.

Step 3. Set Sona-Sweep controls as follows:

SWEEP SELECTOR: LINE LOCK

FUNCTION SELECTOR: 20 KC

LOG SWEEP - LINEAR SWEEP: LINEAR SWEEP

BAND SELECTOR: READ DIRECT

CENTER FREQUENCY: Zero

SWEEP WIDTH: Fully clockwise

OUTPUT LEVEL: Fully clockwise

Attenuation: All out

Step 4. Tune C-55 for maximum flat output as shown on scope screen.

Step 5. Disconnect vertical terminal of scope from T-3 and connect it between either side of T-4 secondary and ground.

Step 6. Tune C-61 for maximum flat output, as presented on scope screen.

6.4 K. Alignment of 200 KC Swept Oscillator (V-18).

Step 1. Interconnect equipment as shown in Fig. 6.5.

Step 2. Set Sona-Sweep controls as follows:

SWEEP SELECTOR: LINE LOCK

FUNCTION SELECTOR: 200 KC

LOG SWEEP - LINEAR SWEEP: LINEAR SWEEP

BAND SELECTOR: READ DIRECT

SWEEP WIDTH: Fully clockwise

OUTPUT LEVEL: Fully clockwise

Attenuation: All out

Step 3. Vary the CENTER FREQUENCY control to position the zero beat at the extreme left-hand side of the pattern displayed on the scope screen.

Step 4. Switch the 50-kc, 100-kc, 150-kc, and 200-kc wave traps into the circuit and adjust L-12 and T-2 until the zero beat appears at the extreme left-hand side of pattern, and the 200-kc mark produced by the wave trap appears at the extreme right-hand side of the pattern.

Step 5. Adjust the 200 KC Sweep Linearity Adj. pot (R-60) to provide equal spacing between the zero beat and the marks produced by the 50-kc, 100-kc, 150-kc and 200-kc wave traps. If proper linearity cannot be obtained by adjusting R-60, the value of R-62 may be changed.

Step 6. Repeat steps 4 and 5 until no further adjustment is necessary.

Note:- An attempt should be made so that, with the SWEEP WIDTH control at its maximum clockwise position, the CENTER FREQUENCY control is capable of shifting the output frequency over a range which will permit the appearance of the zero beat before the extreme counterclockwise position is reached. Conversely, the 200-kc point should be visible before the extreme clockwise position is reached.

6.4 L. Recheck Operation of Buffer-Amplifiers (V-6 & V-7).

Repeat procedure outlined in part J of this procedure with the FUNCTION SELECTOR set to 200 KC.

6.4 M. Adjustment of Synchronous Detector.

Step 1. Provide a connection between the SWP OSC OUTPUT terminal and the vertical input terminal of the scope.

Step 2. Connect the SWEEP OUT terminal to the horizontal input terminal of the scope.

Step 3. Set Sona-Sweep controls as follows:

SWEEP SELECTOR: VAR 0.2 - 1.0

FUNCTION SELECTOR: 20 KC

LOG SWEEP - LINEAR SWEEP: LINEAR SWEEP

BAND SELECTOR: READ DIRECT

SWEEP RATE: Fully clockwise

SWEEP WIDTH: Fully clockwise

Step 4. Adjust the CENTER FREQUENCY control to position the zero beat at extreme left-hand side of trace.

Step 5. Using the OUTPUT LEVEL control and attenuator, set the output of the Sona-Sweep Model M at about 0.05 volt.

Step 6. Disconnect the SWP OSC OUTPUT terminal from the vertical input termina of the scope and connect it to the DET INPUT terminal.

Step 7. Connect the vertical input terminal of the scope between either side of T-6 secondary and ground.

Step 8. Tune C-74 for maximum flat output as shown on the scope screen.

Step 9. Disconnect the vertical input terminal of the scope from T-6 and connect it between the high side of T-8 secondary and ground.

Step 10. Tune C-128 and C-82 for maximum flat output as shown on the scope screen. Shape of output should be similar to the shape of output observed in step 5.

Step 11. Disconnect the vertical input terminal of the scope from T-8 and connect it to the DET OUTPUT terminal.

Step 12. Set the DET GAIN control to give an accurate reproduction of the input waveform, but as a detected envelope.

Step 13. Repeat steps 7 through 12.

Step 14. Set FUNCTION SELECTOR to 200 KC and LOG SWEEP - LINEAR SWEEP switch to LINEAR SWEEP. The waveform should be flat and equal in amplitude to the signal observed on the 20-kc sweep.

6.4 N. Adjustment of 2-KC Sweep and C-W Operation.

Step 1. Connect the SWP OSC OUTPUT terminal to the vertical input terminal of the scope.

Step 2. Connect the SWEEP OUT terminal to the horizontal input terminal of the scope.

Step 3. Set Sona-Sweep controls as follows:

SWEEP SELECTOR: VAR 1 - 5

FUNCTION SELECTOR: 20 KC

LOG SWEEP - LINEAR SWEEP: LINEAR SWEEP

BAND SELECTOR: READ DIRECT

SWEEP RATE: Fully clockwise

SWEEP WIDTH: Fully clockwise

OUTPUT LEVEL: Fully clockwise

Attenuation: All out

CENTER FREQUENCY: Zero

Step 4. Vary the ZERO ADJ control to position the zero beat in center of scope pattern. If ZERO ADJ control is set near one end of its range, the value of R-75 may be changed to bring the setting of the control to approximate center of its range.

Step 5. Set FUNCTION SELECTOR to 2 KC and see that the zero beat remains in approximate center of the pattern.

Step 6. Set FUNCTION SELECTOR to CW and see that the CENTER FREQUENCY control is capable of tuning through a range of zero to 20 kc.

6.4 0. Adjustment of Fixed Markers.

Step 1. Connect SWP OSC OUTPUT terminal to vertical input terminal of scope.

Step 2. Connect SWEEP OUT terminal to horizontal input terminal of scope.

Step 3. Set Sona-Sweep controls as follows:

SWEEP SELECTOR: VAR 1-5

FUNCTION SELECTOR: 20 KC

LOG SWEEP - LINEAR SWEEP: LINEAR SWEEP

SWEEP RATE: Fully clockwise

SWEEP WIDTH: Fully clockwise

OUTPUT LEVEL: Fully clockwise

Attenuation: All out

Step 4. Set BAND SELECTOR to a position for which markers are provided.

Step 5. Set CENTER FREQUENCY control to position the zero beat at extreme left end of scope pattern.

Step 6. Remove the connection between SWP OSC OUTPUT terminal and vertical input terminal of the scope.

Step 7. Connect a detector probe between the vertical input terminal of the scope and either side of T-11 secondary and ground.

Step 8. Tune C-85 to give a maximum flat output as shown on scope screen.

Step 9. Remove the detector probe from T-11 and connect it between C-98 and ground.

Step 10. Tune C-89 to give minimum voltage when all markers are switched off.

Step 11. Check for a marker pulse as each marker switch is turned on.

Step 12. Set SWEEP SELECTOR to LINE LOCK.

Step 13. Adjust L-5 for optimum pulse shape.

Step 14. Repeat steps 8 through 13 with FUNCTION SELECTOR set to 200 KC. Tune C-157 in place of C-85. Tune L-11 for optimum pulse shape and amplitude.

6.4 P. Adjustment of Variable Marker Circuit.

Step 1. Interconnect equipment as shown in Fig. 6.5.

Step 2. Set Sona-Sweep controls as follows:

SWEEP SELECTOR: VAR 1-5

FUNCTION SELECTOR: 20 KC

LOG SWEEP - LINEAR SWEEP: LINEAR SWEEP

BAND SELECTOR: READ DIRECT

SWEEP RATE: Fully clockwise

SWEEP WIDTH: Fully clockwise

OUTPUT LEVEL: Fully clockwise

Attenuation: All out

Step 3. Activate the 20-kc wave trap.

Step 4. Vary the CENTER FREQUENCY control to position the zero beat at extreme left-hand side of scope trace, and the 20-kc mark (produced by the wave trap) at extreme right-hand side of scope trace.

Step 5. Disconnect the vertical input terminal of scope from SWP OSC OUTPUT terminal and connect it between either side of T-9 secondary and ground.

Step 6. Tune C-91 to give maximum flat output as shown on scope.

Step 7. Connect the signal generator to the EXT OSC INPUT terminal. (If the impedance of the generator differs substantially from 50 ohms, an impedance matching circuit is necessary).

Step 8. Set the signal generator output to about 10 or 15 kc, and amplitude at about 0.5 volt rms.

Step 9. Disconnect the vertical input terminal of the scope from T-9 and connect it between the junction of Y-14 and tertiary winding of T-10, and ground.

Step 10. Tune C-95 for maximum flat output as shown on scope.

Step 11. Disconnect vertical input terminal of scope from T-10 and connect it between the junction of C-96 and Y-14, and ground.

Step 12. Tune C-96 to give minimum output, except for an r-f pulse, at the marker frequency.

Step 13. Disconnect the vertical input terminal of the scope from C-96 and connect it across C-98.

Step 14. Set SWEEP SELECTOR to LINE LOCK.

Step 15. Adjust L-10 for optimum pulse shape.

Step 16. Repeat steps 5 through 15 with FUNCTION SELECTOR set to 200 KC and LOG SWEEP - LINEAR SWEEP switch to LINEAR SWEEP.

6.4 Q. Adjustment of Pip Generator (V-15).

Step 1. Connect SWP OSC OUTPUT terminal to the vertical input terminal of the scope.

Step 2. Connect SWEEP OUT terminal to horizontal input terminal of scope.

Step 3. Connect output of signal generator, set at about 10 kc, to the EXT OSC INPUT jack.

Step 4. Set Sona-Sweep controls as follows:

SWEEP SELECTOR: VAR 1 - 5

FUNCTION SELECTOR: 20 KC

LOG SWEEP - LINEAR SWEEP: LINEAR SWEEP

BAND SELECTOR: READ DIRECT

SWEEP WIDTH: Fully clockwise

OUTPUT LEVEL: Fully clockwise

SWEEP RATE: Fully clockwise

Attenuation: All out

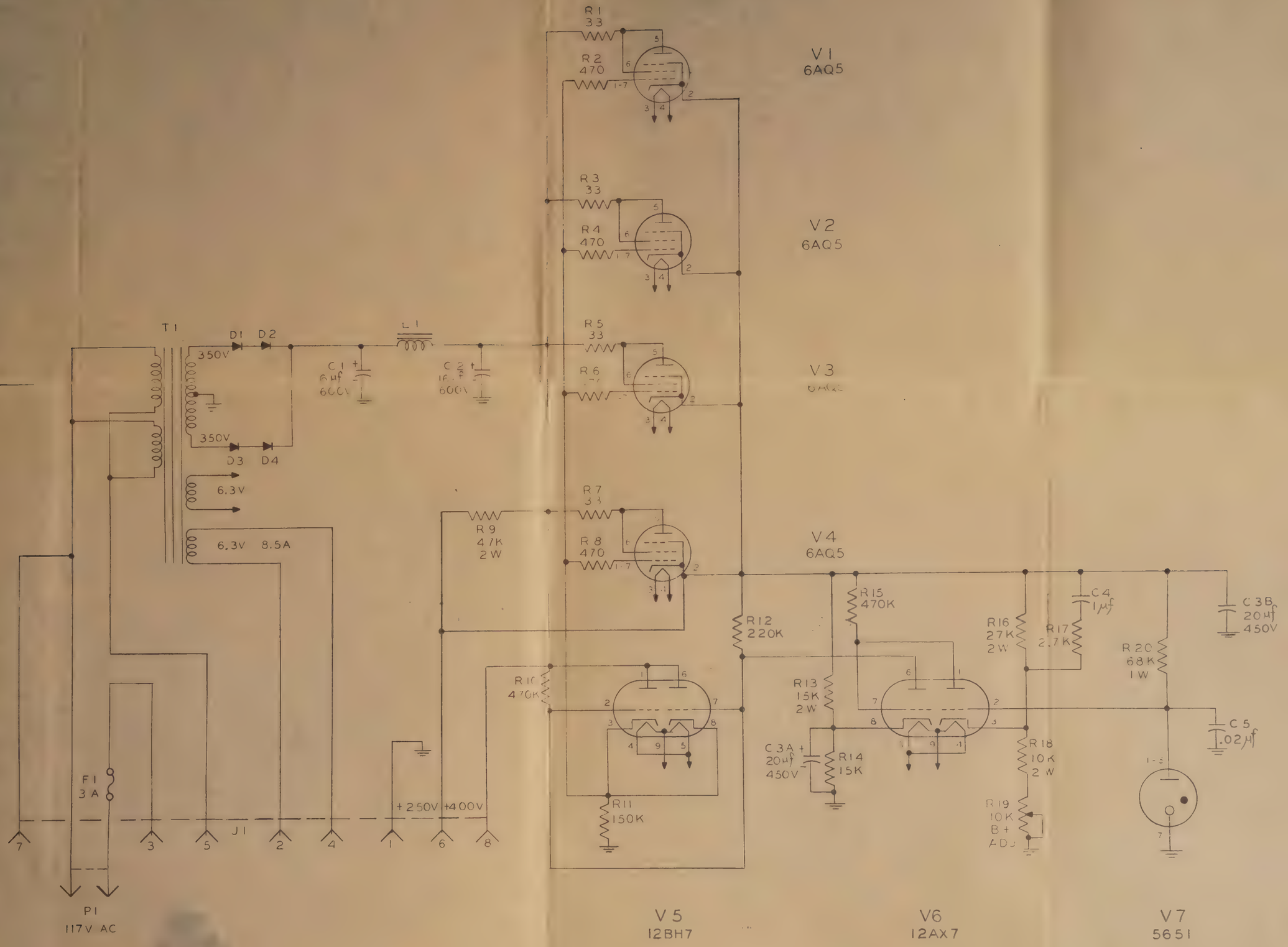
Step 5. Adjust CENTER FREQUENCY control until the zero beat is at extreme left-hand side of scope pattern.

Step 6. Disconnect the vertical input terminal of scope from the SWP OSC OUTPUT terminal and connect it between pin 1 of the Schmitt trigger (V-14) and ground.

Step 7. Set Pip Amplitude Adjust control (R-139) so that with the external PIP ADJ control just short of full clockwise rotation a negative going square pulse appears for each marker crystal pulse, including the variable marker.

Step 8. Disconnect vertical input terminal of scope from the Schmitt trigger and connect it between pin 8 of pip generator V-15 and ground.

Step 9. Set the Pip Generator Adjust control (R-150) to the point at which the leading edge of each negative pulse from Schmitt trigger V-14 produces a single positive pulse for each energized marker crystal.



NOTE
UNLESS INDICATED OTHERWISE
ALL RESISTANCES ARE IN OHMS
ALL CAPACITANCES ARE IN µµf

SCHEMATIC 201-B POWER SUPPLY		
MAT.	FINISH:	SCALE:

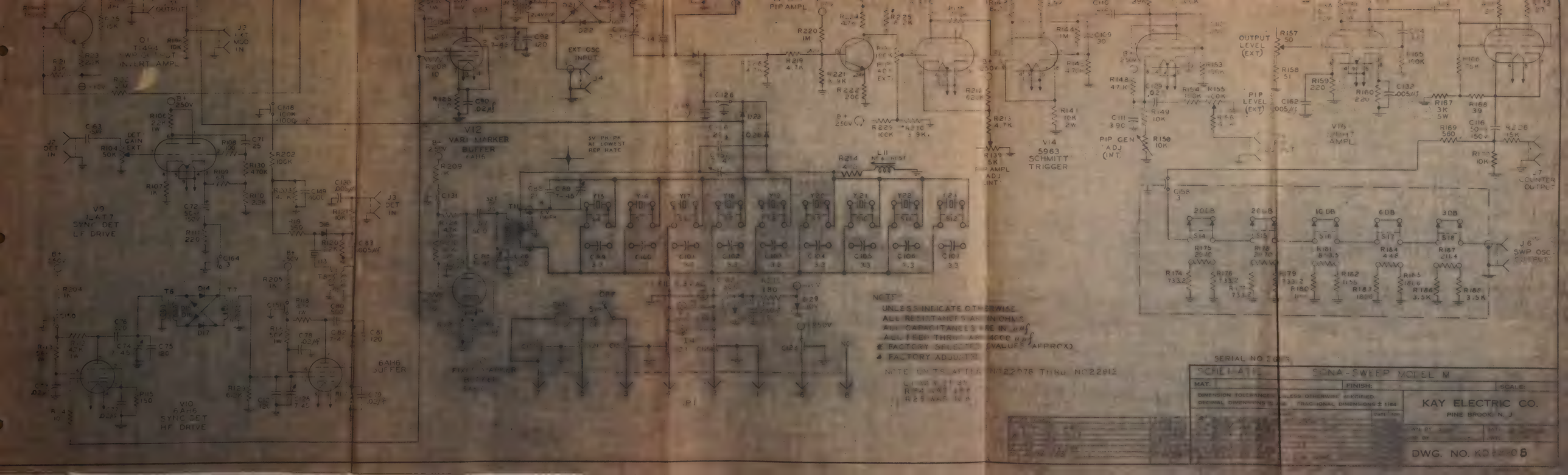
DIMENSIONS TOLERANCES UNLESS OTHERWISE SPECIFIED:
DECIMAL DIMENSIONS ± .002 FRACTIONAL DIMENSIONS ± .005

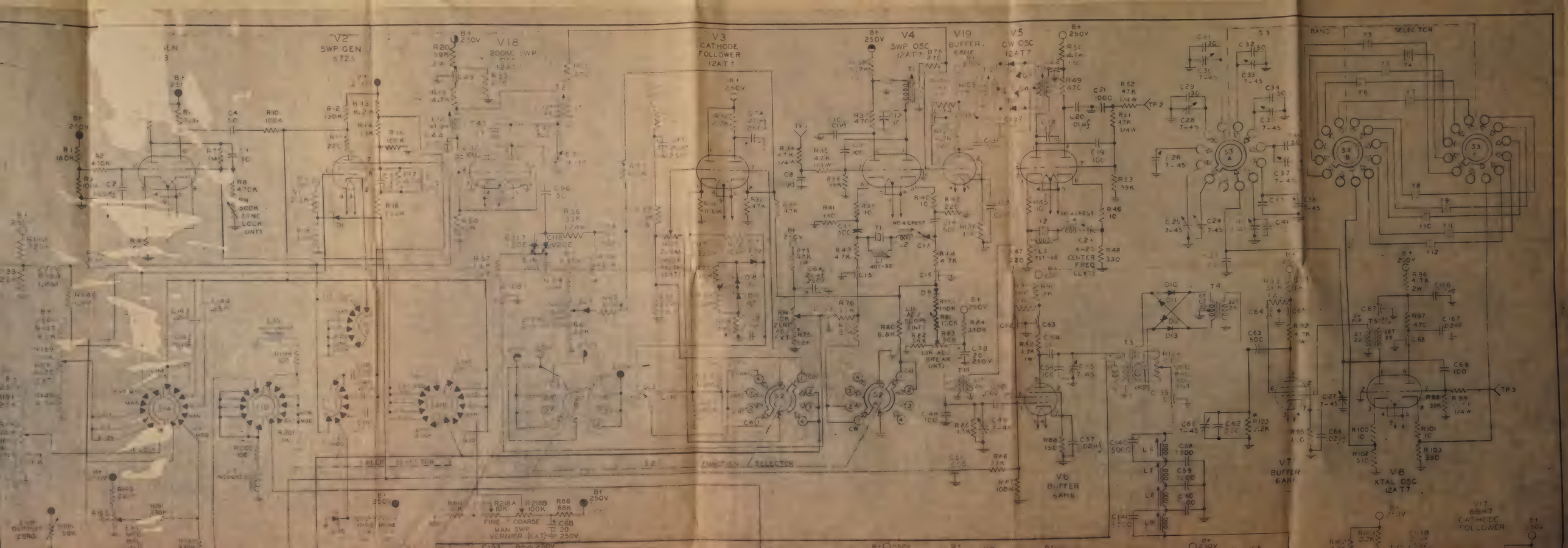
CHANGE	DATE	APP.
"B" - ECN 711		

KAY ELECTRIC CO.
PINE BROOK, N. J.

DWN. BY Joseph Ferris DATE 12/
APP. BY DATE

DWG. NO. KC 7206 B


Q1 T-494 WIPE OUTPUT INVERT AMPL
J3 MOD IN
V9 1-AT7 SYNC DET LF DRIVE
J2 DET IN
DET GAIN EXT
J3 DET IN
V10 6AH6 SYNC DET HF DRIVE
6AH6 BUFFER
V12 VARI MARKER BUFFER 6AH6
5V PK-PK AT LOWEST REP RATE
FIXED MARKER BUFFER
PIP AMPL
EXT OSC INPUT
J4
V13 6AH6 PIP AMPL
PIP ADJ EXT
V14 5963 SCHMITT TRIGGER
PIP GEN ADJ (INT.)
PIP AMPL ADJ (INT.)
OUTPUT LEVEL (EXT)
PIP LEVEL (EXT)
V15 1-AT7 AMPL
20DB
20DB
10DB
6DB
3DB
J6 SWP OSC OUTPUT
J7 COUNTER OUTPUT
OFF
NOTE:
UNLESS INDICATE OTHERWISE
ALL RESISTANCES ARE IN OHMS
ALL CAPACITANCES ARE IN mmf
ALL FEED THRU CAPS 4000 mmf
* FACTORY SELECTED VALUES (APPROX)
▲ FACTORY ADJUST
NOTE UNITS AFTER NO 22078 THRU NO 22812
SERIAL NO 2
SCHEMATIC
SCNA-SWEEP MODEL M
MAT.
FINISH:
SCALE:
DIMENSION TOLERANCES UNLESS OTHERWISE SPECIFIED
DECIMAL DIMENSIONS ± .005 FRACTIONAL DIMENSIONS ± 1/64
DATE
KAY ELECTRIC CO.
PINE BROOK, N. J
DRWN BY
DATE
CHK BY
DATE
DWG. NO. KD 2 0 5


V2
SWP GEN
5725
V18
200KC SWP
12AT7
V3
CATHODE
FOLLOWER
12AT7
V4
SWP OSC
12AT7
V19
BUFFER
6AH6
V5
CW OSC
12AT7
V6
BUFFER
6AH6
V7
BUFFER
6AH6
V8
XTAL OSC
12AT7
V17
6BK7
CATHODE
FOLLOWER
B+
250V
B+
220V
SWEEP SELECTOR
FUNCTION SELECTOR
BAND SELECTOR
FINE COARSE
MAN SWP
VERNIER (EXT)
CENTER
FREQ
(EXT)
LIN AF
SLOPE
(INT)
LIN AF
BREAK
(INT)
NO 4 CREST
NO 4 NEST
CW
LSB
USB
AM
SAM
SYNC
MAN
SWP
INT
EXT
LOCK
OUTPUT
ZERO

August 1963

ADDENDUM

SONA-SWEEP MODEL M

This addendum applies to Sona-Sweep Model M instruments with serial numbers above 26663, exclusive of units with serial numbers between 27101 and 27120 inclusive. Schematic KD-6890-R applies.

1. An External Modulation Input jack (J-3) has been added to enable the sweep oscillator to be swept by an a-c or d-c signal source (or an a-c signal with a d-c component) of approximately 12 volts peak-to-peak. Voltages greater than 12 volts may cause distortion in the sweeping output, whereas, voltages substantially less than 12 volts may result in less than full sweep width.

The 12-volt modulating signal can be positive or negative with respect to ground, or vary both positively and negatively about ground, provided the overall voltage is approximately 12 volts p-p.

A. To operate the instrument while using external modulation -

a) Set the Sweep Selector switch to EXT MOD position.

b) Provide a connection between the external modulation signal source and the EXT MOD IN jack, J-3.

c) Adjust the EXT MOD BAL control (R-190, internal control) for an undistorted presentation on the CRO screen.

The EXT MOD BAL control is used to establish proper operating bias for the sweep generator tube (V-2) and eventually, the driving voltage for voltage-variable capacitor C-17 in the sweep oscillator stage, V-4.

One method that may be used to determine that the EXT MOD BAL control is properly set, is to sample the sweep output at J-1. This is accomplished by applying this signal to the Y-Input terminals on the CRO, using the CRO internal sweep. The resultant CRO trace can then be examined for possible distortion, and the EXT MOD BAL control readjusted, if necessary.

2. A Counter Output jack (J-7) has been added to enable the output of the sweep oscillator to be monitored by an electronic counter, to precisely determine the frequency of the sweeping output.

3. The Manual Sweep potentiometer (R-65) has been replaced by a dual-section potentiometer (R-218A & B) with concentric control shafts, to provide a Coarse and Fine control of the manual sweep function.

38192

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